Commercial and Laboratory Applications, Paper No. 11.1

Configuration of Cryocoolers in Large Electric Power Systems for Superconducting Electrified Transportation Applications for Enhanced Resilience

S. Telikapalli, P. Cheetham, C.H. Kim, S. Pamidi, Florida State Univ., Tallahassee, FL

Superconducting power devices provide the necessary power density to facilitate the development of electric transportation as long as the required cryogenic environment is maintained. For electric transportation applications, there is the need to ensure a high level of system reliability and the loss of a single component should not lead to a system-level failure. Our research focuses on the development of an integrated central cryogenic cooling loop for multiple superconducting devices. In such a system failure of the central cryo-plant would cause the entire superconducting power system to fail. As a continuation of our research on large superconducting power systems, we are exploring the need for additional redundancies to build in resiliency to the cryogenic system while still achieving the targeted power density for the power network. The power density requirement dictates that redundancy would need to be achieved at the system level and not the device level. This study explored the tradeoffs between cryocooler capacity and the required number of cryocoolers to service the cooling loads of the superconducting distribution network in case of partial failure of a superconducting device or when an individual component requires maintenance. The goal is to develop a more resilient cryocoolers based superconducting power system for electrified transportation applications.